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Dipanjan Mondal
Department of Agriculture, Swami Vivekananda University, Barrackpore, West Bengal, India

Sheikh Rameez Akhtar
Department of Agriculture, Swami Vivekananda University, Barrackpore, West Bengal, India

Ria Mukhopadhyay
Department of Agriculture, Swami Vivekananda University, Barrackpore, West Bengal, India

Corresponding Author:
Dipanjan Mondal
Department of Agriculture, Swami Vivekananda University, Barrackpore, West Bengal, India

A review on important diseases of rice in West Bengal

Dipanjan Mondal, Sheikh Rameez Akhtar and Ria Mukhopadhyay

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Abstract
In India 24 percent of cropped area is being occupied by Rice, among which West Bengal ranks first in rice production. Rice, a staple food for billions of people, is susceptible to several devastating diseases that can significantly impact yield and food security. Among these diseases are the important diseases in West Bengal are brown spot, blast disease, sheath blight, and bacterial blight, each caused by different pathogens and exhibiting distinct symptoms.
Brown spot of rice: Caused by the fungus *Bipolaris oryzae*, it leads to small, circular lesions with brown centers and yellow halos on the leaves. These lesions can coalesce, causing extensive damage to the foliage.
Blast of rice: Rice blast, caused by the fungus *Magnaporthe oryzae*, is one of the most destructive rice diseases globally. It manifests as diamond-shaped lesions on leaves, stems, and panicles, eventually leading to complete plant destruction.
Sheath blight: *Rhizoctonia solani* is the causal agent of sheath blight. This disease results in elongated lesions on leaf sheaths and stems, often causing lodging and reduced grain filling.
Bacterial blight: Caused by the bacterium *Xanthomonas oryzae* pv. *Oryzae*, bacterial blight affects leaves, producing water-soaked lesions that later turn necrotic. These lesions often have a characteristic "angular" appearance, as they are limited by leaf veins.
Management of these diseases involves a combination of cultural practices, resistant varieties, and chemical treatments. Integrated disease management approaches involving biological control agents, such as *Trichoderma* and *Pseudomonas*, can contribute to reducing disease severity and enhancing overall crop health.

Keywords: Rice, brown spot, blast disease, sheath blight, bacterial blight, management practices

Introduction
Rice (*Oryza sativa*); is the major cereal crop which is consumed by half of the world population every day. A hot, humid atmosphere is required for the rice production. It works best in areas with high humidity, continuous sunlight, and a reliable supply of water. Rice is a major meal in west Bengal and is essential to the area's economy. It is nutritious and has a high protein and carbohydrate content, which gives you immediate energy. But the productivity or rice is suffering huge loss due to insect pest attack and weed infestation. Pathogens are thought to be responsible for 15%-30% of the yield loss in rice, which is estimated to cost roughly USD 33 billion yearly. Numerous diseases that affect rice plants, including blast, leaf blights, sheath blights, sheath rot, brown spot, and tungro, are brought on by a broad variety of phytopathogens. These diseases reduce crop production and quality, among other agricultural losses (Nayak *et al*., 2021) [12]. In West Bengal condition important diseases of rice are blast, brown spot, bacterial blight, sheath blight that can cause significant damage to the plant (Fig. 1) (Prasher *et al*. 2022) [13].

Important diseases of rice in West Bengal
Brown spot of rice: In 1943, a catastrophic famine in Bengal caused a disease that lowered the yield of rice to 40–90%, and it is believed that 3 million people starved to death as a result of this disease. Nothing as disastrous as the 1942 Bengal rice brown spot pandemic has been documented in plant pathology literature, in accordance to the Crop Life Foundation (Kifer 2016). This disease is also referred to as fungal blight.

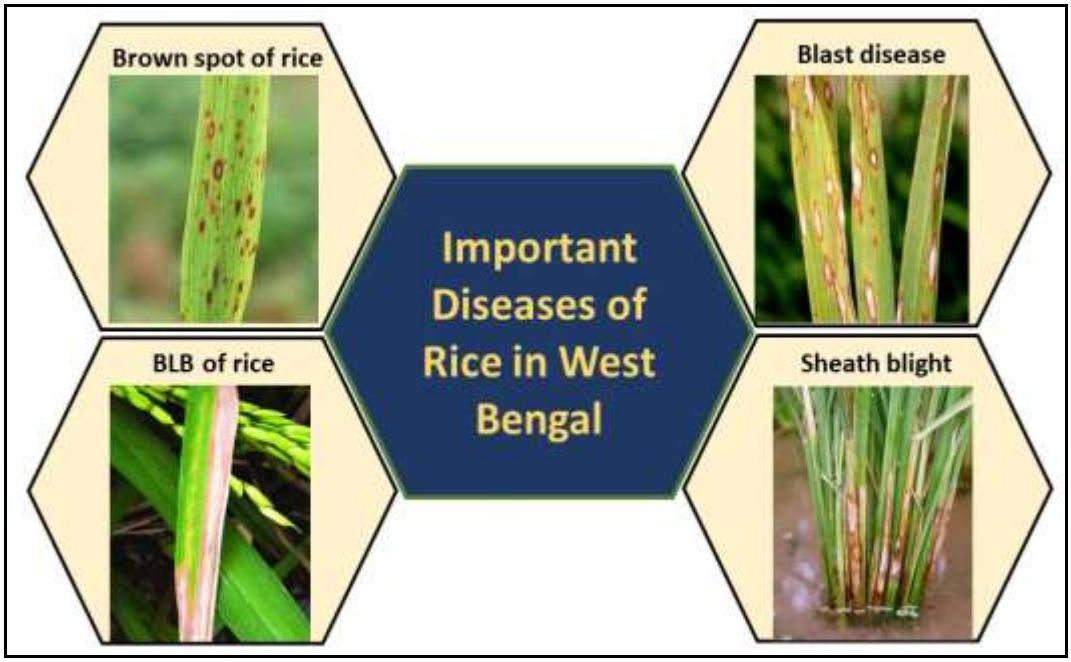

Fig 1: Important diseases of rice in West Bengal

Etiology: *Bipolaris oryzae*, also known as *Helminthosporium oryzae*, is an imperfect fungus that causes brown spots on rice. According to Ito and Kuribayashi in 1927, *Ophiobolus miyabeanus* is the ideal stage of the fungus.

Symptoms: Coleoptile blight, oval, dark brown to purplish-brown patches on the leaves, reduced photosynthetic capacity in rice plants, and finally burning and death of the leaves are all symptoms of the disease. There have been reports of early senescence infected leaves, fewer tillers, and reduced root and shoot elongation. From the seedling stage to the milk stage, the pathogen infection is visible. The distinctive brown patches on leaves sometimes have a grey or white core and have an oval to cylindrical form. Numerous spots cluster together, and the leaf withers. When the glumes are diseased, the grains begin to shrivel (Surendhar *et al*. 2021) [20].

Pathogen survival

It has been found that the pathogen may persist in the plant debris and several other weed hosts like *Setaria italica, Leersia hexandra* etc. as a primary inoculum. It is discovered that the pathogen infects more than 50 species of the gramineous family (Dagnachew Lule *et al*. 2014) [5]. A combination of constant rain, cloudy weather, and an excessive daytime temperature, quickens the spread of the disease. For the infection to become severe, the host leaf must be moist for 8 to 24 hours and there should be a shortage of N or K (Surendhar *et al*. 2021) [20].

Disease Management Practices

- According to Laxman Aryal *et al*. (2019) [1], *Oryzae* sp. has a wide genetic background that comprises cultivars that are entirely vulnerable [Mithila (2.34 tons/ha)] and somewhat resistant [Radha-4 variety (5.420 tons/ha)] to Brown spot disease. Mizobuchi *et al*. (2016) [11] reported quantitative trait loci (QTLs) controlling resistance to brown spot disease.
- *Trichoderma*, *Bacillus*, and *Pseudomonas* were the most often utilized commercially available bio-control agents.
- According to Carvalho *et al*. (2010) [3], a balanced nutrient supply is the greatest strategy for lowering the prevalence of several disorders, particularly in brown spot. The brown spot resistant varieties are becoming vulnerable due to loss of nutrients like Fe, Mn, K, and Zn. According, to reports, application of silicon boosts the host plants' immunogenic activity to various biotic stimuli in addition to reducing the occurrence of brown spots (Surendhar *et al*. 2021) [20].
- Application of various fungicides such as Propiconazole @ 0.1%, Hexaconazole @0.2%, captan among others have proved to be highly effective (Surendhar *et al*. 2021) [20].

Blast of Rice

Blast disease outbreaks can result in significant losses in agricultural crops with rice suffering a 70–80% yield loss. According to reports, the blast in South India in 1920 caused loss of about 80% to the crop (Saha 2022) [14].

Etiology: Rice blast disease is caused by the anamorph fungus *Pyricularia oryzae* Cavara, and teleomorph *Magnaporthe oryzae* ((Hebert) Barr). The five species that make up the genus *Magnaporthe* are *M. grisea, M. oryzae, M. salvinii, M. poae*, and *M. rhizophila* - which have same physical characteristics including three-septate fusiform ascospores and black, non-stromatic perithecia (Chikkaballi *et al*. 2022) [4].

Symptoms: The rice plant is nearly entirely affected by the blast disease, which can attack the plant at any stage of crop growth. Nursery blast, leaf blast, node blast, neck blast, and panicle blast are some of the names given to the symptoms at various stages. The infected plants exibits lesions that cause them to wilt and rot. On the leaf surface spindle spots with greyish centre and dark brown coloured margin are observed. In severe infection nodes and neck portion become blackish in colour, rots and grains are damaged or lost.

Saha (2022) [14] conducted a comparison study using three consecutive years' weather data of West Bengal. It was noted that the weather was ideal for *Pyricularia oryzae*, the pathogen that causes blast disease. Additionally, the crop stages during which disease rapidly develops were noted. The relationship between PDI values and plant age, corresponding pathogenic spore concentration, and five climatic data was examined using

multiple regression analysis (MRA). By using the step-down equation, it was found that as plant age, airborne spore concentration, RH, and rainfall rise, so does the severity of the disease in both seasons.

Management

There are several strategies to manage rice blast such as crop rotation, use of resistant varieties like Rasi, Vikash, IR-64, Himalya-1, Himalya-2 etc., fungicide application, and cultural practices such as pruning of infected areas and cleaning the fields are helpful to prevent the spread of the disease. (Skamnioti, P. and Gurr, S.J. 2009) [18].

Bacterial leaf blight

One of the main rice diseases, Bacterial Leaf Blight Disease (BLB), which is known to be the global epidemic. in many parts of the world, can cause yield loss by more than 50% (Dai *et al*. 2007) [6].

Etiology: Bacterial leaf blight is one of the first known diseases, discovered by Japanese farmers in 1884 and is caused by the bacterium *Xanthomonas oryzae* pv. *oryzae* (Xoo) (Tagami and Mizukami 1962) [21]. The bacteria enter through the hydathodes present at the leaf tips and leaf edge. The Xoo grows inside the xylem vessel, blocking it and leading the plant to wilt.

Symptoms: Both leaf blight and "kresek" symptoms are signs of BLB, which affects rice at all stages of development. Generally, on both leaf edges, but rarely on only one, the disease is distinguished by linear, yellow to straw-colored stripes with wavy borders. The wild rice varieties *Oryza rufipogon*, *O. berthii*, and *O. glaberimma* contain BLB resistance genes that are also present in *O. sativa* (Singh *et al*. 2013) [16].

Management

- Using resistant variety like IR-54, Laxmi etc.
- Use clean seeds from certified sources and avoid over fertilization of fields.
- Practice good field management. (Gnanamanickam, S. *et al*. 1999) [7].

Sheath blight of rice

Sheath blight disease is a significant barrier to the intensification of the cultivation of rice in South East Asian nations, resulting in an annual yield loss of 8 to 50 percent. The sheath blight disease of rice (*Oryza sativa*) is caused by the fungus *Rhizoctonia solani*, which is the most damaging species of *Rhizoctonia*. Most of the world's rice-growing regions use those varieties that are vulnerable to sheath blight (Basu *et al*. 2016) [2].

Causal organism: The pathogen *Rhizoctonia solani* causing sheath blight in rice is a waterborne and also a soilborne fungus. The pathogen is able to persist for two crop seasons as sclerotia or mycelia before being spread by irrigation water or air (Kumar *et al*. 2009) [10]. Basu *et al*. (2016) [2] discovered that the resistant rice variety Swarnadhaan (IET 5656) and the susceptible variety Swarna (MTU 7029) were both early hosts of the sheath blight pathogen. Investigations on entire plants revealed that the disease was more severe in Swarna than in Swarnadhaan and the later cultivar had a disease index that was 50% lower than Swarna in a detached leaf assessment.

Symptoms: *R. solani* mostly affects the leaf sheath and leaf blades of rice plants, yet in serious conditions it can also infect the entire plant, including newly formed panicles. The disease may occur at any stage of plant growth, the tillering stage of the rice crop being most susceptible. The usual symptom is the emergence of round, rectangular, or ellipsoid, about 1 cm long, greenish-gray water-soaked lesions on the leaf sheath close to the water level. These lesions grow larger and take on an uneven appearance, with a gray-white centre and brown edges (Senapati *et al*. 2022) [15].

Management

- Crop rotation with non-cereal crop.
- Using resistant varieties like PR-108, Mandira, Nalini, Sabita etc.
- Seed treatment with sedaxane @ 0.1%
- Soil treatment with thiram @ 3g/sq. m as a foliar spray.
- Several actinomycetes, various species of *Trichoderma*, *Gliocladium*, *Aspergillus* have been found to manage sheath blight disease (Senapati *et al*., 2022) [15].
- Apply carbendazim or benomyl @ 0.1% at 45, 55 and 65 days after transplanting (Singh *et al*., 2019) [17].

Conclusion

Rice is one of the most important food crops in India, and it is essential to keep the crop healthy and protected from various plant diseases. Proper management practices can help to prevent or avoid disease outbreaks in rice field. Farmers must be aware of these diseases and strategies to protect their crop.

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